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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/770,369	02/03/2004	Kenji Horiuchi	T0203.0005/P005	1815
24998	7590	06/10/2005	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			LOUIE, WAI SING	
2101 L Street, NW			ART UNIT	
Washington, DC 20037			PAPER NUMBER	
			2814	

DATE MAILED: 06/10/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/770,369	Applicant(s) HORIUCHI ET AL.	
	Examiner Wai-Sing Louie	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6, 7, 9-18, 21-26 and 30-41 is/are rejected.
- 7) ☒ Claim(s) 5, 8, 19, 20, 27-29 and 42 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>3/04, 2/04</u> | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Claim Objections

Claims 1-37 are objected as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- It is unclear what is meant by “a diamond crystal formed on the diamond substrate to high-density excitation”. For the purpose of examination, “a diamond crystal formed on the diamond substrate by high-density excitation”, is assumed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 6-7, 9-16, 18, 21-26, 32, 34-37, and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shiomi et al. (US 5,812,573) in view of the admitted prior art (US Pub 2004/0155573).

With regard to claim 1, Shiomi et al. disclose a diamond semiconductor laser (col. 4, line 66 to col. 14, line 49 and fig. 3) comprising:

- A diamond substrate 54 (fig. 3);

- A diamond crystal 56 formed on the diamond substrate 54, but do not disclose the diamond layer is formed by high-density excitation. However, the admitted prior art disclose it is known that high-density excitation of diamond causes the high-brightness and high efficient emission particularly in laser oscillation (US Pub. paragraph [0006]). Shiomi et al. and admitted prior art have substantially the same environment of laser diode formed by diamond crystal. Therefore, it would have been obvious the diamond crystal 56 and the light-emitting mechanism 58 are formed by high-density excitation in order to have high-brightness and high efficient laser emission.

With regard to claims 2-3, 6, and 39-40, Shiomi et al. modified by the admitted prior art would disclose the high-density excitation has an intensity beyond 10^{20} cm^{-3} (US Pub. paragraph [0009]), but do not disclose the carrier density is equal to or greater than 100 Acm^{-2} and the high-density excitation is spatially limited to an area equal to or less than 0.01 cm^2 . However, the carrier density and the area are considered to involve routine optimization, which has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as the carrier density and the area etc. would have been obvious:

“Normally, it is to be expected that a change in temperature, or in thickness, or in time, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed “critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”

In re Aller 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmscher* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any carrier density and area suitable to the method of the process in order to optimize the design.

With regard to claims 4, 7, 26, and 41, Shiomi et al. do not disclose the high-density excitation is formed by etching. However, the claimed limitation is written in process language, which does not carry any patentable weight in a device prosecution.

With regard to claim 9, Shiomi et al. modified by the admitted prior art would disclose the controlling temperature is equal to or lower than 170 K (US Pub. paragraph [0009]).

With regard to claim 10, Shiomi et al. disclose a spatial confinement structure of the carriers (fig. 3).

With regard to claim 11, Shiomi et al. disclose the spatial confinement structure of the carriers comprises a stack of layers including at least two layers with different electric characteristics (col. 12, lines 7-21 and fig. 3).

With regard to claims 12-13, 16, Shiomi et al. disclose a pn junction (col. 12, line 16).

With regard to claim 14, Shiomi et al. disclose the p-type layer 54 comprised of a boron-doped diamond (col. 11, line 48).

With regard to claim 15, Shiomi et al. disclose the n-type layer 58 comprised a phosphorus-doped diamond (col. 12, line 15).

With regard to claim 18, Shiomi et al. disclose the confinement structure is formed by introducing crystal defects into a region of the crystal by impurity doping (col. 11, line 40).

With regard to claim 21, Shiomi et al. disclose a diamond substrate 54, but do not disclose the diamond substrate functions as a heat sink. However, where the claimed and the prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established. *In re Best*, 195 USPQ 430, 433 (CCPA 1977).

With regard to claims 22-23, Shiomi et al. modified by the admitted prior art would disclose the diamond crystal has a nitride concentration is equal to or less than 10 ppm (US Pub. paragraph [0010]) and boron concentration is equal to or less than 100 ppm (Shiomi col. 11, line 22).

With regard to claims 24-25, Shiomi et al. disclose a laser diode (col. 11, line 35), but do not disclose the reflection mirrors constituting the optical cavity and the cavity length are optimized for an emission wavelength of EHP. However, it would have been obvious for the one with ordinary skill in the art to recognize a semiconductor laser comprises a pair of reflective mirrors and the cavity length is determined by the distance between the mirrors.

With regard to claims 32, 34-37, Shiomi et al. disclose the diamond semiconductor laser device 12 is a light source (fig. 1a).

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shiomi et al. (US 5,812,573) modified by the admitted prior art (US Pub 2004/0155573) as applied to claim 1 above, and further in view of Yamamoto et al. (US 6,316,826).

With regard to claim 17, Shiomi et al. do not disclose the electrodes are composed of titanium. However, titanium is a common material for electrode such as disclose in Yamamoto et al. forming a metallization layer (electrode) on a diamond substrate (Yamamoto col. 5, line 39). Yamamoto et al. disclose the titanium is good adhesion material (Yamamoto col. 5, line 40). Therefore, it would have been obvious at the time the invention was made to modify Shiomi's device with the teaching of the admitted prior art and Yamamoto et al. to use titanium as electrode material in order to adhere to the diamond layer.

Claims 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shiomi et al. (US 5,812,573) modified by the admitted prior art (US Pub 2004/0155573) as applied to claim 1 above, and further in view of Gillich et al. (US 6,848,797).

With regard to claim 30, Shiomi et al. do not disclose the reflecting mirrors composed of an Al film. However, Gillich et al. disclose using aluminum film as reflector (Gillich col. 3, lines 31-40). Gillich et al. teach Al film could be easily made with varies methods such as foil composite, laminate, CVD, and the surface could be easily grind, polish, or blast into high brightness (Gillich col. 3, lines 1-20). Thus, it would have been obvious for the one with ordinary skill in the art to modify Shiomi's device with the teaching of Gillich et al. to provide an Al film as reflecting mirror in order to form the Al film easily on the device.

With regard to claim 31, Shiomi et al. modified by Gillich et al. would disclose the reflecting mirrors composed a dielectric multilayer film (Gillich col. 1, lines 61-67).

Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shiomi et al. (US 5,812,573) modified by the admitted prior art (US Pub 2004/0155573) as applied to claim 1 above, and further in view of Bortscheller et al. (US 6,747,406).

With regard to claim 33, Shiomi et al. do not disclose the diamond semiconductor laser device is used as a pumping source for fluorescent material. However, Bortscheller et al. disclose a layer of phosphor material 60 is deposited on the laser diode 42 (Bortscheller fig. 5). Bortscheller et al. teach the phosphor converts the part of the UV light emitted by the laser diode into longer wavelength and combining with the UV light to generate a visible light (Bortscheller col. 1, lines 18-28). Shiomi et al. and Bortscheller et al. have substantially the same environment of laser diode generating UV light. Hence, it would have been obvious for the one with ordinary skill in the art to modify Shiomi's device with the teaching of the admitted prior art and Bortscheller et al. to provide a layer of phosphor material in order to generate visible light.

Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shiomi et al. (US 5,812,573) modified by the admitted prior art (US Pub 2004/0155573) as applied to claim 1 above, and further in view of Okushi et al. (US 6,815,721).

With regard to claim 38, in addition to the limitations disclosed in claim 1 above, Shiomi et al. also disclose:

- A second diamond layer 58 formed on the first diamond layer 56 and functioning as an emission layer (col. 11, lines 38-44 and fig. 3);
- Shiomi et al. do not disclose forming a third diamond layer on the second diamond layer 58. However, Okushi et al. disclose a third diamond layer 23

formed on the light-emitting layer 25 (Okushi col. 7, lines 23-39 and fig. 8).

Okushi et al. teach the three layers forms a PIN light-emitting structure to make the device with even greater efficiency (Okushi col. 2, lines 25-34). Shiomi et al. and Okushi et al. have substantially the same environment of diamond semiconductor laser diode emitting bright UV light. Therefore, it would have been obvious at the time the invention was made to modify Shiomi's device with the teaching of Okushi et al. to provide a third diamond layer to form a PIN light-emitting structure in order to achieve greater efficiency for the device;

- Shiomi et al. modified by Okushi et al. would disclose a first electrode 27 formed on the first diamond layer 24 (Okushi fig. 8);
- Shiomi et al. modified by Okushi et al. would disclose a second electrode 27 formed on the third diamond layer 23 (Okushi fig. 8).

Allowable Subject Matter

Claims 5, 8, 19-20, 27-29, and 42 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for allowance:

The prior art of record does not disclose or suggest either in singly or in combination the following limitations and other elements in the claims:

- Reference Shiomi et al. and the admitted prior art do not disclose:

Art Unit: 2814

- The high-density excitation is formed by diamond-isolated particles.
- The isotope composition ratio of at least part of the diamond is controlled.
- The reflecting mirror planes of the diamond laser are formed by a (111) cleaved plane.
- The cavity is composed of micro-spheres.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (571) 272-1709. The examiner can normally be reached on 7:30 AM to 4:00 PM.

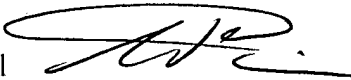
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2814

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Wsl

June 8, 2005.

A handwritten signature in black ink, appearing to be 'Wsl', written over the typed name 'Wsl'.